Laparoscopic colotomy suture using clips and Connell techniques in goats: A comparative study

Rafid H. Farman
Coll. of Vet. Med. / Univ. of Al-Qadisiya
Mohammad J. Eesa
Coll. of Vet. Med. / Univ. of Baghdad
email: rafidm4@yahoo.com
(Received 3 August 2014, Accepted 4 September 2014)

Abstract

The aim of the study was to investigate and evaluate the colotomy closure via laparoscopic device using clips and Connell mattress suture technique. Sixteen adult female healthy local breed goats were used. They were divided randomly into two equal groups, Connell suture technique and clips mattress groups. The operations were done under the effect of general anesthesia using IM injection of xylazine 2% (0.05 mg/kg BW) and ketamine 5% (3mg/ kg BW) mixture. Under aseptic technique colotomy were done laparoscopically, the colotomy incision was closed by connell suture pattern in connell's group using 2/0 polygalactin 910 suture material, and by clips technique in clips group using 10 Medium- Large titanium legating clips. Each group was divided into two equal subgroups depended on follow up of histopathological examination at a periods of 7 and 21 days post- surgery. The results of clinical examination revealed that the activity and appetite of animals were return early to the normal level, also the physical findings returned to the normal level value with a short time after operation in both groups. The histopathological findings of two groups appeared that there was an inflammatory phase at a period of 7 days post operation, but the granulation tissue and collagen fiber formation was more prominent in connell's group compared with clips group, while at the 21 days post operation in both groups revealed that a granulation tissue in the incision site which covered by epithelial layer with thick fibrous connective tissue and presence of myofibroblast at the incision site. This indicated that the wound was in a mature phase which was clear in connell's group than in the clips group.

Key words: Laparoscopy, colotomy, clips, Connell, goats

استخدام الجراحة المنظارية لخياطة القولون في المعز بتقنيتي المشبك المعدني و كونيل: دراسة مقارنة

محمد جواد عيسى
كلية الطب البيطري/ جامعة القادسية
رافد هادي فرمان
كلية الطب البيطري/ جامعة بغداد

الخلاصة

هدفت الدراسة لتحقق وتقييم التئام شق القولون باستخدام طريقة المنظار باستعمال تقنيتي كونيل والمشبك المعدني. سته عشر من اناث المعز المحلي استخدمت. قسمت الحيوانات عشوائيا" الى مجموعتين متساويتين (مجموعات خياطه بتكنيك كونيل ومجموعات المشبك المعدني). اجريت العمليات الجراحية تحت تأثير التخدير العام باستعمال الزايلازين 2% (0.05 ملغم \كغم من وزن الجسم والكيتامين 5% (3ملغم \كغم من وزن الجسم) حقنا" بالعضل، تحت تقنية التطهير الجراحي وبطريقة الجراحة المنظارية تم عمل شق القولون وتم اغلاق شق القولون بخياطة تقنية كونيل في المجموعة كونيل وباستعمال الخيط الجراحي الممتص بولي كلاكتين 910 (حجم 0-2). وبتقنية المشبك المتقطع في المجموعة المشبك المتقطع باستعمال مشبك التيتانيوم حجم كبير - متوسط . قسمت كل مجموعة الى مجموعتين فرعيتين اعتمادا" على اختبار فحص المتابعة النسيجية المرضية للفترات 7 و21 يوما" بعد العملية. اظهرت نتائج الفحص السريري الى ان الفعالية والشهية عادت مبكرا" الى المعدلات الطبيعية وكذلك المعايير الفيزيائية اصبحت ضمن المعدلات الطبيعية وبوقت قصير بعد العملية. أوضح الفحص النسيجي المرضي لكلا المجموعتين ان المجموعتين في الطور الالتهابي في اليوم السابع بعد العملية و تكون النسيج الحبيبي والياف الغراوين (الكولاجين) كان اكثر وضوحا" في مجموعة كونيل مقارنة بمجموعة المشبك المعدني بينما اظهر الفحص المرضي النسجي لكلا المجموعتين لفترة اليوم الحادي والعشرين بعد العملية الى

وجود النسيج الحبيبي في منطقة الشق الجراحي مغطى بطبقة من الظهارة مع وجود نسيج ليفي ضام ووجود خلية الارومة العضلية الليفية في مكان الشق الجراحي والتي تشير الى ان الجرح أصبح في مرحلة النضوج التي كانت اكثر وضوحا "في مجموعة كونيل مقارنة بمجموعة المشبك المعدني.

الكلمات المفتاحية: الجراحة المنظارية ، خياطة القولون في المعز ، تقنية المشبك المعدني ، تقنية خياطة كونيل .

Introduction

Laparoscopic surgery is a surgical procedure making by the help of a video camera and several thin instruments during surgical procedure, small incisions are made to produce ports through these incision to insert telescope and the instruments which allow access to the inside of the patient (1). The laparoscopic either called minimally invasive or key-hole technique is useful for viewing internal organs, biopsy, diagnosis of different intra-peritoneal disorders and surgical correction (2). It causes minimal damage in tissue, rapid patient recovery and diagnostic accuracy these make laparoscopic technique over the traditional laparotomy (3). Colotomy mean make an opening in the wall of colon to treat certain defect like perforation, ischemia, malpositioning, infection and diagnostic or supportive procedures such as biopsy, then suturing by several ways (4). It is a dirty procedure that requires caution by all involved to prevent contamination and being the main cause of peritonitis and anastomotic leakage, abscess formation, and death are more suitable complications, while adhesions and postoperative obstruction and stenosis are very rare, either the hemorrhage from the incision ends, which can leads to hemorrhagic shock (5, 6). The colotomy is closed with two rows of absorbable suture material. This method exposes less suture material to the peritoneal cavity and could reduce risk of adhesions to foreign material. An enterotomy might be required in the small colon to remove an impaction with food material or enterolith. Laparoscopy for colon diseases began in 1990 and has established a role in benign disease. Early observations and experiences demonstrated feasibility of laparoscopic surgery for a variety of colon disease processes, but the applicability to colonic carcinoma is unclear (7, 8). The aim of the study was to compare between two techniques (Connell's and clips) for closure of longitudinal colonic incision via laparoscopic surgery.

Materials and methods

Sixteen adult healthy local breed does were used, aged range between 2-3 years and 25-30 kg of weight. The animals were divided randomly into two equal groups as the following. The connell's suture technique and clips suture group. Each group was divided into two equal subgroups (4 animals of each) depended on follow up of histopathological examinations at a periods of 7 and 21 days post operation. In addition to the clinical and physical examination was achieved to determine the condition of the animals. Titanium clips, and clip applier were used in suture in this study further to the ordinary laparoscopic instruments (Fig. 1, 2). Animals were off feed 48 hours and water within held 24 hours before operation. The ventral abdominal area from xiphoid cartilage to the pubis and laterally to the left and right flank as far as possible was prepared aseptically. The operations were done under general anesthesia using xylazine hydrochloride 2% (alfasan WOERDEN-HOLLAND) (0.05mg/kg B.W) and ketamine hydrochloride 10% (KEPRO B.V.-HOLLAND) (3 mg /kg B.W) intramuscularly. The anesthetic drug (ketamine) was repeated in a half dose (1.5 mg/kg B.W) if necessary. The anesthetized goat was laid on dorsal recumbency (9). The animal underwent laparoscopic colotomy according to the following steps: The trocar-cannula was introduced through small incision (1-1.5cm) in the skin, the subcutaneous tissue, and muscles were blunt dissected by artery forceps. Four port positions were selected; 1st port: at the midline between umbilicus and xyphoid cartilage 5cm from umbilicus for introducing of telescope (Fig. 3). 2nd port: at left para midline 5cm from 1st port, and 3cm from

umbilicus for introducing scissor then uses to introduce clips applicator in clips suture group or needle holder in Connell suturing group. 3rd port: at left para midline 4cm from 2nd port and 5 cm from umbilicus. 4th port: at right para-midline 11cm from 1st port, and 5cm from umbilicus. The 3rd and 4th ports used for introduce graspers forceps (Fig. 4). Abdomens were inflated with CO2 under pressure (8 mm.gh). The colon was stretched enough by the two grasper's forceps in opposite direction to facilitate the incision performance. About 2.5-3 cm incision was done by the laparoscopic scissors (Fig. 5). The colon incision in group (A) was closed by Connell suture technique, using 2/0 polygalactin (910) suture material and a surgeon knot tying was applied in each stitch (Fig. 6). In group B, the colotomy was closed by using titanium clips. The colon was grasped near the two commeasure of the wound and stretched in opposite direction to bring the wound edges in contact. This allowed the clips to include the wound edges together. The clip was loaded in the jaw of the clips applier, three to four clips were needed to close the colonic incision (Fig. 7). Blood or any colon content which may be spillage from the colotomy was aspirated by suction and irrigation cannula. The muscles and peritoneum in abdominal wall was closed by simple continuous suture pattern by using 0 cut gat suture material and close the skin by horizontal mattress technique using 0 silk suture mattress (Fig. 8). Animals were given penicillin-streptomycin (Combi-Kel 20 + 20, Kela Labarotoria, Belgium) 10.000 I.U/Kg BW of penicillin and 20mg/kg BW of streptomycin intramuscularly for 5 days post operation, also intravenous fluid therapy (Sodium chloride 0.9 % and glucose anhydrase 5 %) (ADWIC. Egypt) was administered 90 ml/Kg /hr. for one day post operation. Green foods were given for 4-5 days then gradually animals were returned to the normal food. Clinical observation such as activity of animals and food intake, were registered and skin sutures were removed 10 days after the operation.

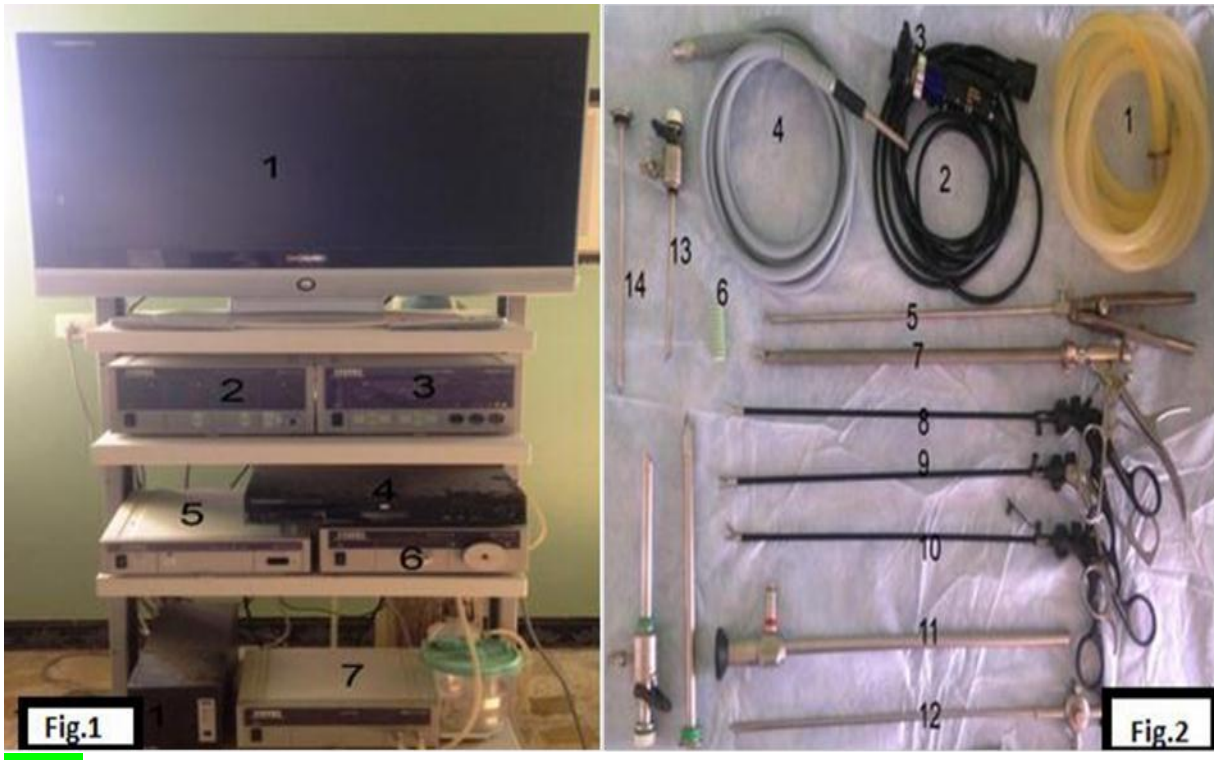


Fig. 1: Laparoscopic apparatus, LCD monitor (1), Insufflator unit (2), Electro-cautery (3), DVD recorder (4) Video-camera system (5) , Xenon light sources (6), and suction-irrigation machine (7). Fig. 2: Laparoscopic instruments used in the experiments. Insufflator tube(1), Cable of camera (2), Head of camera (3), Light cable (4), Needle holder (5), Titanium clips (6), Clip applier (7), Grasper forceps (8,9), Scissor (10), Telescope (11), Suction and irrigation cannula (12), Cannula (13), Trocar (14).

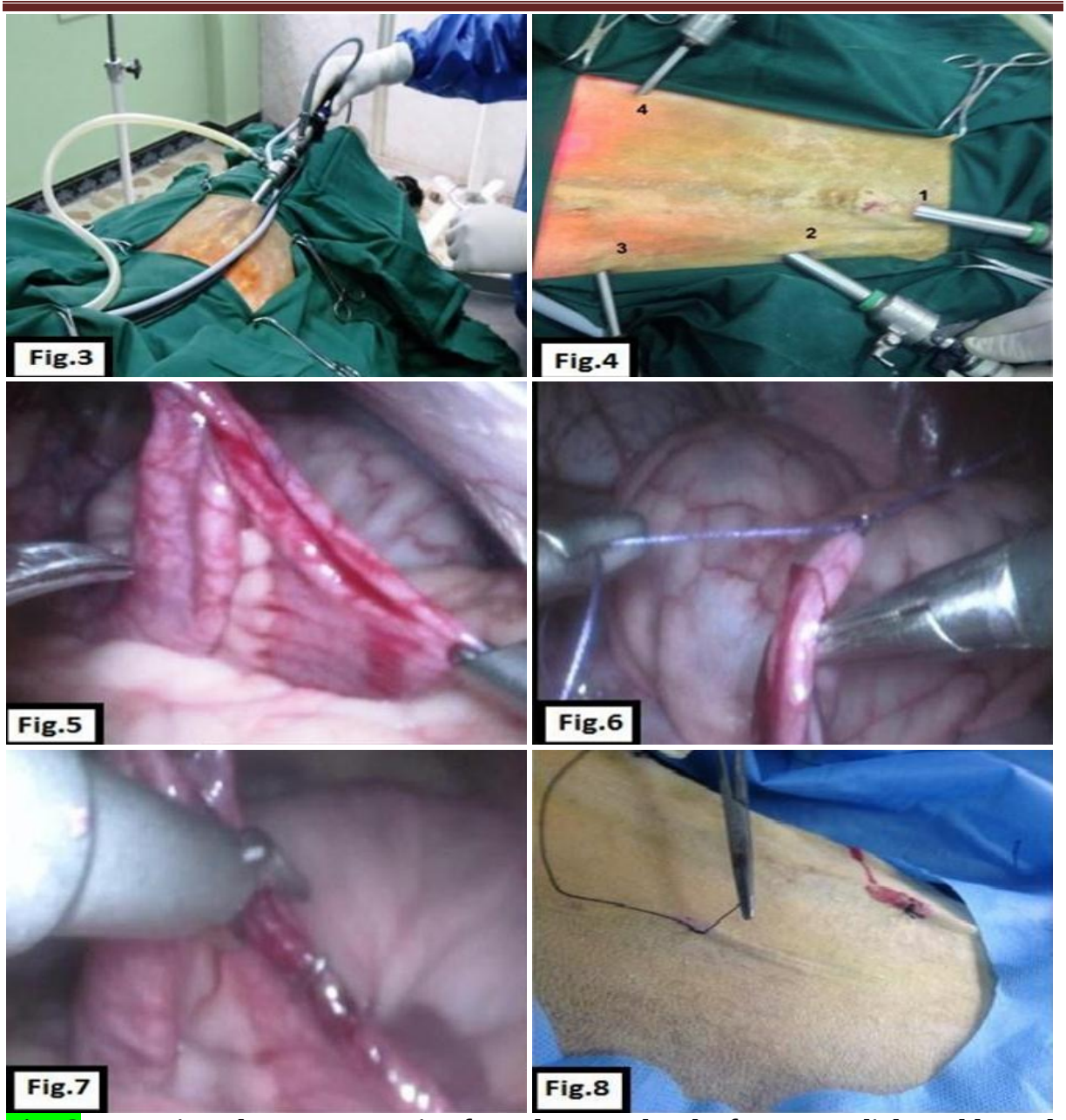


Fig. 3: Insertion the 1st ports site for telescope, head of camera, light cable and insufflator tube. Fig. 4: The ports site for telescope and laparoscopic instruments (1) (10mm) for telescope, (2) (10mm) for scissor or needle holder or clips applicator and (3), (4) (5mm) for grasper. Fig. 5: Laparoscopic section shows the incision in colon that done by the laparoscopic scissor. Fig. 6: Laparoscopic section shows the start of suturing by connell technique using 2/0 polygalactin 910 suture material. Fig. 7: Laparoscopic section shows closing of the colon incision by the titanium clips. Fig. 8: Closing of skin using horizontal mattress suture.

Results

Clinically signs of pain were observed on animals in both groups within few hours after operation, then disappearance at the second day. All animals return to the normal condition and normal apatite on the second day postoperative. There were no mortality in animals neither hernia, nor tearing of incisional site. During the days 2–4 post surgery there was slight swelling at the site of incision where disappear after 5 days post-surgery. The duration of operations in both groups were found 46.4 ± 5.6 min. in clips suture technique while in Connell's group was 70.7± 3.8 min. After exploratory

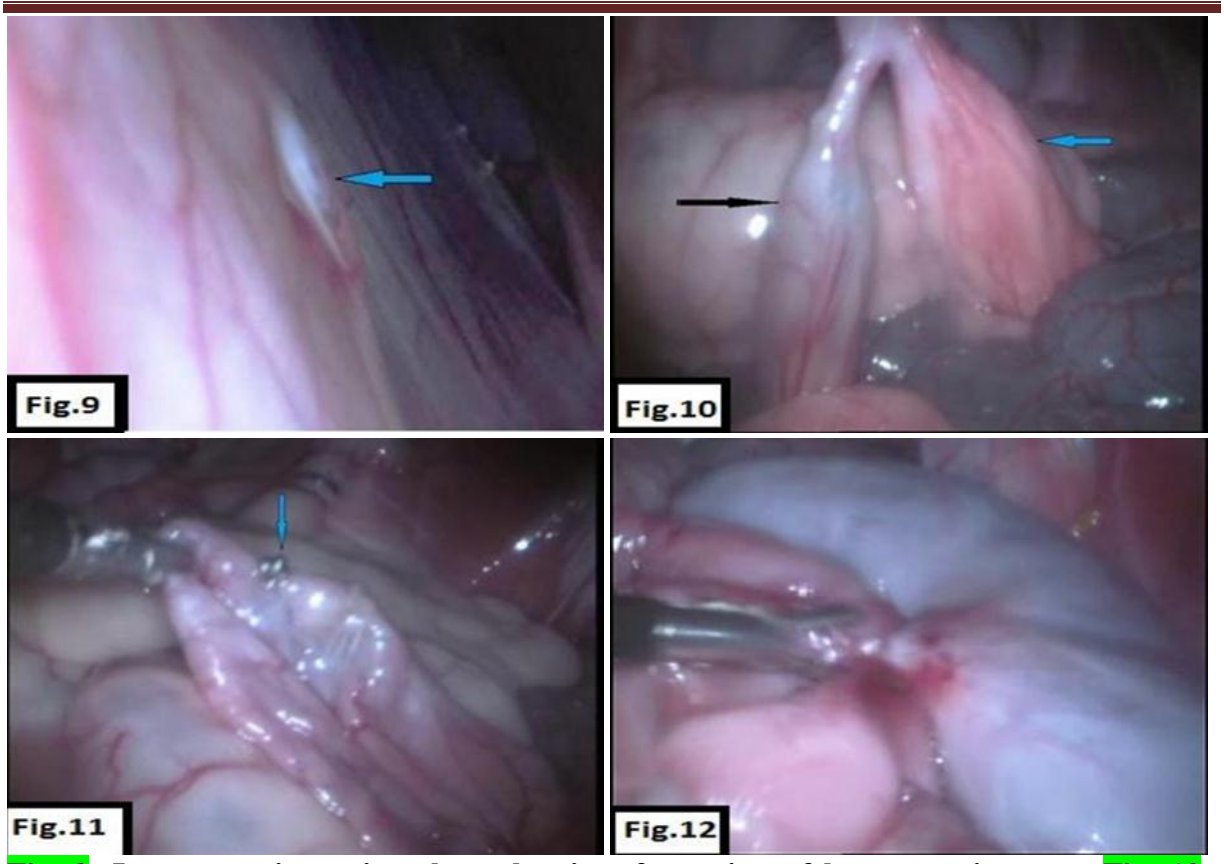
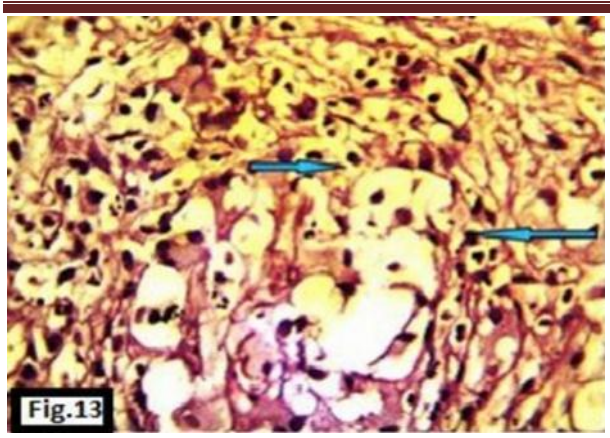
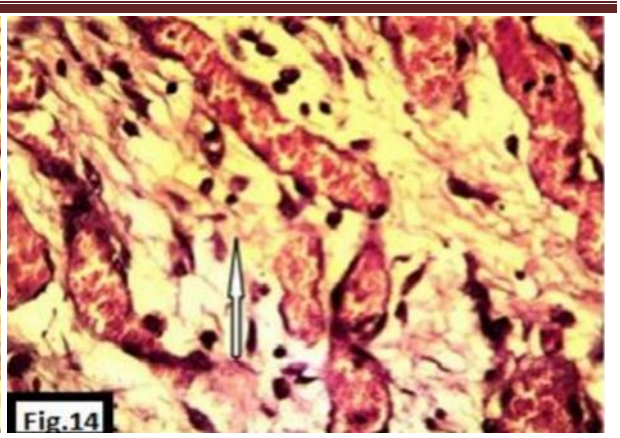
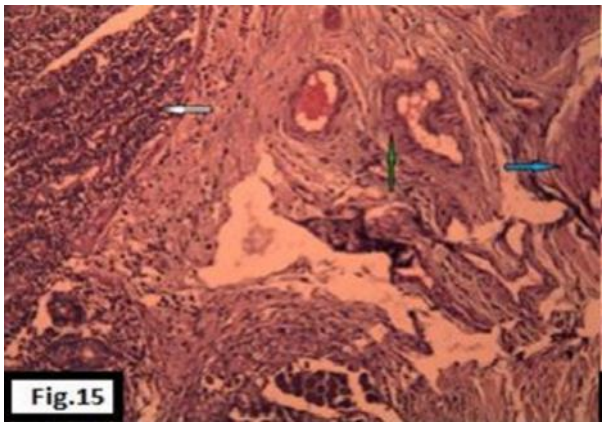


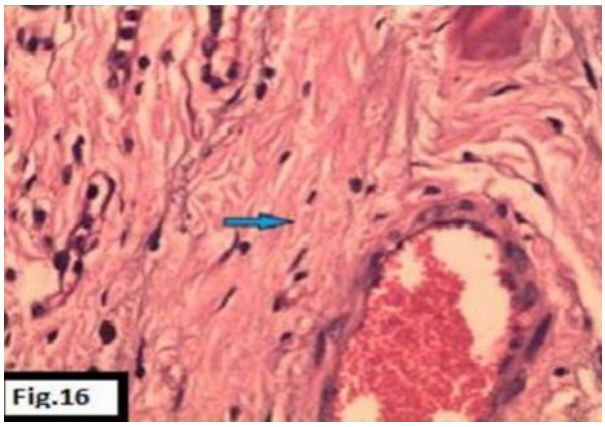
Fig. 9: Laparoscopic section show the site of entering of laparoscopic port. Fig. 10: Laparoscopic section show the adhesion between colon and the omentum. in Connell group. Fig. 11: Laparoscopic section show the site of clips in colon. Fig. 12: Laparoscopic section show the adhesion between colon and the omentum in clips group.

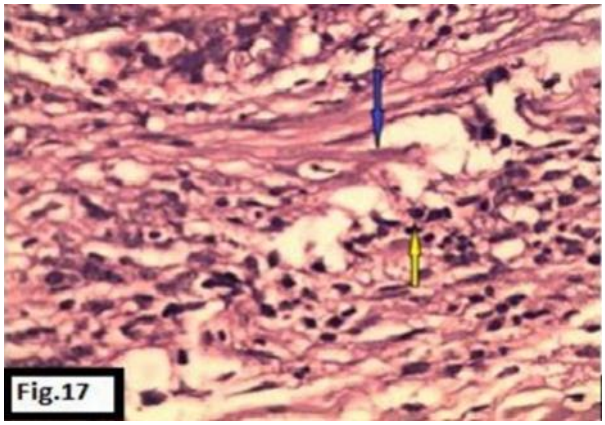
laparoscopy there were no adhesions seen between the site of ports of laparoscopic instrument and the viscera or omentum (Fig. 9), also no adhesion founded between the colotomy site and the omentum (Fig. 11), except one animal of Connell group and two animals of clips group (Fig. 10,12), also no leakage or abscess found at the colotomy incision site except one case in Connell's group. The histopathological changes seen in connell's suture group at 7 days post-surgery include infiltration of neutrophyl and mononuclear cells at the site of incision and around degradation suture materials (Fig. 13).There was granulation tissue formation consisting from congested capillaries and fibroblast deposit collagen fiber in serosa started to form in the base of the incision, also showed fibrin deposition and neutrophils infiltration in the incision site (Fig. 14). At 21 days post-surgery, the histopathological lesions were presence of suture space contain suture materials, myofibroblast and surrounded by dense fibrous connective tissues around dissolved suture materials. Proliferation of epithelial cells, excessive regular fibrosis were formed in the site of incision and formation of muscle fibers also seen (Fig. 15). The signs of inflammation like congestion of blood vessels and infiltration of the inflammatory cells and fibroblast were decreased in number in mature connective tissue (Fig. 16). In clips suture group at 7days post-surgery, there was Moderate connective tissue around the incision line with few fibroblasts infiltration in the mucosa (Fig. 17), granulation tissue in serosa layer characterized by scattered inflammatory cells and fibroblast also were seen (Fig. 18). At 21 days post-surgery, there were proliferation of fibroblast to form network of irregular fibrosis around the incision site with new blood vessels formation (Fig. 19), also few infiltration of inflammatory cells in lamina properia with few blood vessels, fibroblast, that form irregular and immature connective tissues were seen (Fig. 20).

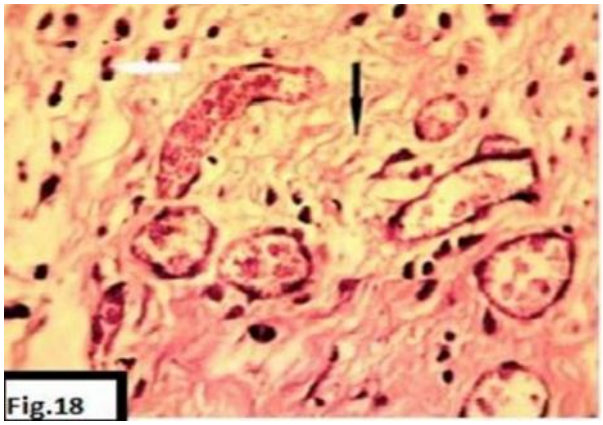


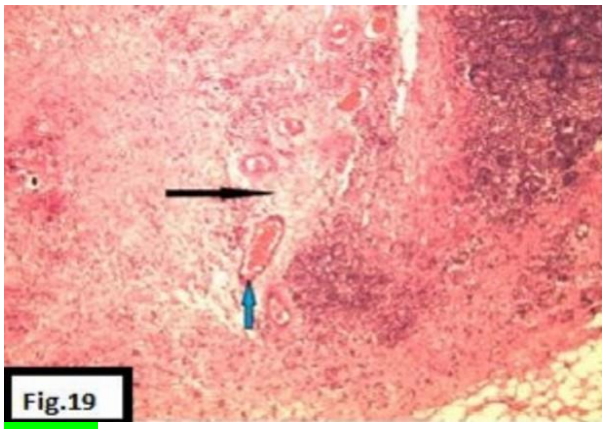












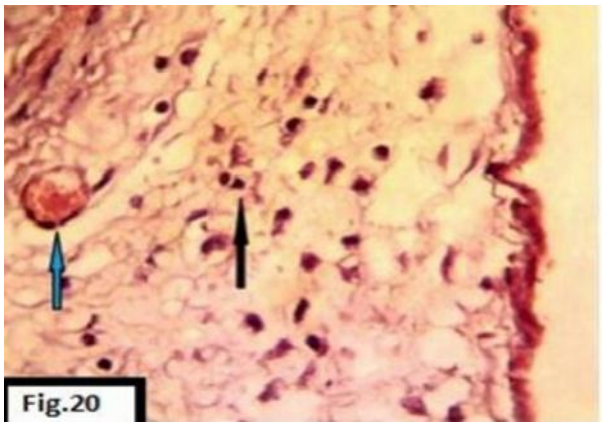


Fig. 13: Microscopic section shows there was infiltration of neutrophil and mononuclear cells in connective tissue around degradation suture materials (arrow) after 7days post-operation in Connell group (H&E 40X). Fig. 14: Microscopic section shows there was granulation tissue consisting from congested capillaries blood vessels and fibroblast deposit collagen fiber in serosa (arrow) after 7days post-operation in Connell group (H&E 40X). Fig. 15: Microscopic section shows there was mononuclear cells infiltration

in fibrosis around dissolve suture materials (green arrow) proliferation of epithelial cells (white arrow), excessive regular fibrosis and formation of muscle fibers (blue arrow) after 21days post-operation in Connell group (H&E 10X). Fig. 16: Microscopic section shows few fibroblast and mononuclear cells infiltration in mature connective tissue (arrow) after 21days post-operation in Connell group (H&E 40X). Fig. 17: Microscopic section shows moderate connective tissue around incision line (blue arrow) and few fibroblasts (yellow arrow) in the mucosa after 7 days post-operation in clips group (H&E 40X). Fig. 18: Microscopic section shows granulation tissue in serosa layer (black arrow) and scattered inflammatory cells and fibroblast (white arrow) after 7 days post-operation in clips group (H&E 40X). Fig. 19: Microscopic section shows proliferation of fibroblast to form network of irregular fibrosis (black arrow) with few formation of blood vessels (blue arrow) at 21 days post-operation in clips group (H&E stain 4X). Fig. 20: Microscopic section shows few inflammatory cells infiltration in lamina properia, few blood vessels (blue arrow), few fibroblast (black arrow) at 21days post-operation in clips group (H&E stain 40X).

Discussion

From the clinical finding of this experiment found that, the both techniques are safe and all animals return to normal condition in short time, this may be due to the small size of skin incision which decrease the damage of tissues then stress factor on animal and decreased the probability of incision contamination, this result is agreed with (10, 11).The time of operation shown significant differences at the level of $p< 0.05$ between two groups, the connell's group need more time than the clips group due to that the suturing techniques laparoscopically are more difficult than clips which need high skills and more practice and time than clips. These results are agreed with the others (12, 13, 14) whom reported that clips techniques is significantly shorter than the hand-sewn techniques laparoscopically. Macro-laparoscopic view declare no presence of adhesions between the skin port incision and omentum, this may due to the small size of incision which decrease the tissue damage and decreased the probability of adhesion. This result performed by other researcher (15,16). Besides that, less adhesion may be related to the effect of CO_2 which regarded as antiseptic of abdominal floara. This agreed with (17,18), founds that CO_2 significantly decreased the growth of *Staphylococcus aureus* then clear intraperitoneal infections. The adhesion between the colotomy site and omentum in connell its maybe due to the bleeding that observed throw the entering of needle through the colon layers, this blood clot lead to adhesion, or exteriority apart of suture material out of incision line may the cause of adhesion, while in clips group the adhesion may due to the everting of the border of the incision and exposed of mucosa which regarded as source of microflora of abdomen cavity lead to increasing of inflammatory phase and formation of fibrin and increase the probability of adhesions. These observation were coincided with other researchers (19, 20), whom found that laparoscopic intestinal resection and anastomosis can be applied safely and have less morbidity rate without intra-abdominal adhesion of the omentum and even the bowel to the abdominal wall compare with conventional laparotomy technique in dogs. Histopathologically at 7days post-surgery in both groups, observe infiltration of inflammatory cells. This may due to increase porosity of blood vessels by the action of the chemical mediators which released from platelets and mononuclear cells. This result agreed with (11). The granulation tissue formation in connell's group is consist of new blood vessels, proliferation of fibroblast with collagen production and mononuclear cells infiltration, that revealed the early start of proliferation phase before few days ago, this result is agreed with (21), who suggestion the fibroblasts begin entering the wound site three to five days after wounding where the ending of the inflammatory phase

making the onset of proliferative phase. In the clips suture group the proliferation sign seen less than that of the connell's group, that means the proliferative phase start at this period 7 days post-surgery, that delay in proliferation may due to the pressure of clips on the incision line which compromised the blood flow, this observation agreement with (22), which performed that tight stapling reduced suture line blood flow to the incision line. Or the delay in clips group may be due the presence of micro abscesation on the edge and surface of serosa which caused prolong in inflammatory phase either decreased in fibroblast then decreased in collagen formation (19). The histopatho-logical findings in Connell's group at 21 days post-surgery show granulation tissue in the incision site which covered by epithelial layer consist of columnar cells and excessive regular fibrous connective tissue, sub-epithelial layer and myofibroblast closed the suture space. This mean the inflammatory process at ending phase, because the presence of myofibroblast, decreased in fibroblast and blood vessels in the wound site revealed to the wound in mature phase, this result agreed with (23), while in clips group show granulation tissue as in a network of irregular fibrosis around the incision site with presence of blood vessels and fibroblast. Adoption to the fact that the proliferation of fibroblasts no irregular connective tissue and decreased blood vessels which means there is a delay in the phase of the spread and the wound does not reach maturation, these results agreed with (24) whom say that eversion or tissue overlap in intestine border retards healing and should be avoided, delayed fibrin seal formation, delayed mucosal re-epithelialization, increased mucocele formation, prolonged inflammatory response usually narrows the lumen sometimes resulting in stenosis the everting clips suture was delay in healing than normal. While in connell's Inverting suturing are characterized by a rapid serosa to serosa seal and adhesion formation, more clearly in healing and fast (25). Either this result disagrees with (26). So the stages of maturation phase were clearer in Connell's group than in the clips group. In conclusions of this study revealed that the healing of connell's suture technique was better and faster than clips suturing.

References

1-William H (2003) New technique in laparoscopy. www.laparoscopic roux-en-y-procedure.

2-Monnet E, Twedt DC (2003) Laparoscopy vet. Clinic small animal 33:1147-1163.

3. Chung CC (2007) A brief update on laparoscopic assisted colectomy. Medical bulletin Vol.12,No.6.

4-Freeman D (2010) Complications in colic surgery and how to avoid them. Italian Association of Equine Veterinarians (SIVE). pp. 100-105. http://www.ivis.org.

5-Freeman D (2010) Challenge technique in colic surgery. Italian Association of Equine Veterinarians (SIVE), pp: 82-90.

6-White RN (2010) Complications of gastro-intestinal surgery. International Congress of the Italian Association of Companion Animal Veterinarians (SCIVAC), pp:251-252.

7-Sazhin VP, Gostkin PA, Sazhin AV, Siatkin DA (2006) Laparoscopic surgery of colon cancer. Khirurgiia (Mosk), (8):21-26.

8-Yoo J (2008) Laparoscopic Colorectal Surgery. The Permanente J., 12(1):27-31.

9-Ivany JM, Muir WW (2004) Farm Animal Anesthesia. In: Farm animal surgery. Fubini SL and Dusharme NG Saunders Company Pp: 97 – 112.

10-Maiti SK (2010) Laparoscopic-assisted diagnosis and surgical management of different intraperitoneal disorder in dogs. 35th World Small Animal Veterinary association Congress (WSAVA). www.ivis.org.

11-Eesa MJ, Khalaf FH, Ali AF (2012) Laparoscopic assisted colonotomy suture using aversion and inversion techniques in goats. Al-Anbar Journal of Veterinary Sciences Volume: 5 (1): 149-155.

12-Bermas H, Fenoglio ME, Haun W, Moore JT (2004) Laparoscopic Suturing and Knot Tying A Comparison of Standard Techniques to a Mechanical Assist Device JSLS. 8(2): 187–189.

13-Gopaldas RR, Reul RM (2010) A novel and simplified technique. Texas Heart Institute J., 37(4):435-438.

14-Hayashibe A (2013) The comparison of clinical results between hand suturing and mechanical stapling for gastrojejunostomy and jejunojejunostomy after SSPPD. International Journal of Surgery. 11(2):161–163.

15-Gutt CN, Oniu T, Schemmer P, Mehrabi A, Buchler MW (2004) Fewer adhesions induced by laparoscopic surgery. Surg. Endoscopy, 18: 898-1006.

16-Novitsky YW, Litwin DE, Callery MP (2004) The net immunologic advantage of laparoscopic surgery. Endoscopy. 18:1411-1419.

17-Persson M, Svenarud P, Flock JI and Vander-Linden J (2004) Carbon dioxide inhibits the growth rate of staphylococcus aureus at body temperature. Surg. Endosc., 19:91-94.

18-Neuhaus SJ, Watson DI (2004) Pneumoperitoneum and peritoneal surface changes. Surgical endoscopy and other interventional techniques, 18 (9):1316-1322.

19-Dauod MS (2007) A comparative study between two methods of intestinal anastomosis in goat. M.Sc. thesis college of vet. Medicine, Baghdad University. Baghdad – Iraq.

20-Abass BT, Ali OJ (2008) Comparison of laparoscopic and conventional surgery of intestinal anastomosis in dogs. Iraqi J. of Vet. Sci., 22(1):13-19.

21-Vegad JL (2007) A textbook of veterinary general pathology. Tissue repair. 2nd.ed ch.5. Pp 183-191.

22-Chung RS (1987) Blood flow in colonic anastomoses. Effect of stapling and suturing. Ann. Surg., 206(3):335-339.

23-Deodhar AK, Rana RE (1997) Surgical physiology of wound healing: review. J. Postgraduate Medicine (JPGM). 43. (2): 52 -56.

24-Ellison GW (2011) Reducing your complications with small animal surgery. Proceedings of the Southern European Veterinary Conference (SEVC). www. Ivis.org.

25-Brown DC (2003) Small intestine. In: Textbook of small animals surgery. Slatter D. Saunders Company .Pp:646-650.

26-Ibrahim JKh (2010) A comparative study between cross mattress and schmiedens suture techniques on colon end- to- anastomosis in goats. M.Sc. thesis, Vet. Medicine College. Baghdad University. Iraq.